DOCUMENT RESUME

ED 339 345 IR 015 287

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TITLE Computers and Telecommunications at National Technological University.
PUB DATE 89
NOTE 7p.; Reprinted from: University Computing v12 n2 1990.
PUB TYPE Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Communications Satellites; Computer Networks; *Continuing Education; Cost Effectiveness; *Distance Education; Educational Innovation; Educational Television; Electronic Mail; *Engineering Education; Higher Education; National Programs; Nontraditional Education; *Telecommunications
IDENTIFIERS *National Technological University

ABSTRACT

The National Technological University (NTU), a consortium of approximately 30 American engineering schools which has been in operation on a continent-wide scale since 1985, uses telecommunications to broadcast engineering education courses to corporate sites across the country. Courses are produced at member institutions and are distributed to sponsoring sites via a communications satellite network. NTU represents a blend of distance education, corporate education, and continuing education in its pursuit of a cost effective, national engineering program. The uses of computer, educational television, electronic mail, and other innovative educational technologies have made distance learning opportunities possible, for corporate engineers and technical personnel, that compare favorably with those offered by traditional institutions. A program modelled after NTU has been developed in Europe. The European Programme of Advanced Continuing Education (PACE) is based on university and industrial cooperation and will ultimately link many corporations together in nearly a dozen European countries. NTU presents a model for the success of nontraditional education in an increasingly technology-based world by providing the opportunity for balancing national needs for a better trained workforce and the immediate needs of corporations for skilled professionals. (21 references) (Author/DB)

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Computers and Telecommunications at National Technological University

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Abstract The National Technological University (NTU), a consortium of approximately 30 American engineerin schools, broadcasts courses to corporate sites across the country. Courses are produced at member institutions and are distributed to sponsoring sites via a satellite network. The National Technological University represents a blend of distance education, corporate education, and continuing education. The uses of computer and telecommunications technology by NTU have made possible cost-effective distance learning opportunities for corporate engineers and technical personnel that compare favourably with those offered by traditional institutions.

Introduction

NTU is designed for the professional engineer who is working in the field and who already has a bachelor's degree. The university has no undergraduate programs; neither does it offer a doctorate. It offers only course work leading to the Master of Science degree in various branches of technology or applied science. Students must be sponsored by their corporate employers who pay their tuition.[1] While many students are working toward degrees, some take classes to update their professional knowledge or to become familiar with related disciplines.

The need to automate our courses

This innovative institution is an interesting blend of distance education, corporate education, and continuing education. The instructional process employed by NTU and most other distance education institutions utilizing instructional television (ITV) is in many respects a mediated continuation of age-old teaching practices: lecture, demonstration, and discussion, and at the same time, a revolution in education with important differences. The most obvious difference in the case of ITV courses is that some, if not all, of the students are at physical locations removed from the instructor; consequently, the possibilities for discussion are limited. The single most important difference from an administrative standpoint is in the quantity of technology, hardware, and personnel required to link instructors and students at a distance.

The uses of computer technology by NTU distinguish it from other types of distance education institutions. At NTU, the computer serves as an educational tool, as a method of facilitating instruction, and as the object of study itself. Students may use interactive computer linkage to apply for admission, or they may interact with their professors or fellow students at other sites by electronic mail.[2] Homework assignments and other instructional materials including diagrams and pictures can be transmitted instantaneously from instructors to students at worksites by satellite.

Garrison and Shale[3] maintain that the term 'distance education' implies the involvement of two-way communication between teacher and students, the majority of which occurs noncontiguously. Distance education uses technology to mediate the two-way communication. The computer's potential as a distance education tool has only begun to be tapped. Technology is making possible distance learning opportunities that compare favourably with those provided in more traditional educational environments.

The revolution in communications has greatly improved the quality of distance education. Likewise, the revolution in technology has increased the demand for instruction available through distance education. Technical advances are occurring rapidly and are so highly specialized that workers and professionals need frequent and continuous retraining. By means of distance education techniques corporations can retrain their personnel as often as necessary without their employees leaving their job sites.

The founding of NTU

The primary impetus for the establishment of NTU was the need in the United States for top quality engineers with current knowledge.[4] The ratio of master's degrees to bachelor's degrees awarded in engineering in the United States has been steadily declining. The dearth of holders of master's degrees makes those with bachelor's degrees more valuable to industries which offer high salaries but few opportunities to pursue advanced degrees. Yet these same companies which lure graduate engineers away from further education are in constant need of continuing education for their new employees. The intensity with which that need is felt can be inferred from the following comment: 'With the possible exception of medicine, no other academic discipline (besides

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engineering) has fused so tight a bond between education and the profession it serves'.[5]

NTU was incorporated as a nonprofit corporation in the State of Colorado on January 18, 1984. It grew out of the Association for Media-Based Continuing Education for Engineers (AMCEE), a consortium of universities with engineering schools which was begun in the 1970s for the purpose of offering noncredit courses and seminars for engineers via tape and satellite. NTU was created for the purpose of offering graduate credit courses for the same audience. The institution involves three sets of organizations: the NTU central administration, a group of participating institutions which provide the courses and academic expertise, and a group of sponsoring organizations from business and industry which have contracted with NTU for employee programs and educational services.[6]

NTU offers eight majors: (1) Computer Engineering, (2) Computer Science, (3) Electrical Engineering, (4) Engineering Management, (5) Manufacturing Systems Engineering, (6) Materials Science, (7) Management of Technology, and (8) Aerospace.[8,9] In addition to classes for credit, NTU offers non-credit short courses and seminars live during prime-time 5 days a week through a recently established branch of NTU, Advanced Technology and Management Programs (ATMP).[8,9] NTU also broadcasts some special interest credit courses which serve the dual purpose of providing continuing enrichment to technical professionals and serving as breadth electives to those in graduate programs.

The participating institutions provide the instruction and academic expertise. Courses are broadcast live by almost all institutions. At institutions whose uplinks are not yet installed and functional, classes are taped and broadcast by other institutions. As of the spring term 1989, the participating institutions included Arizona Stat University, Boston University, Colorado State University, General Motors International Engineering and Manufacturing Institute, Georgia Institute of Technology, Illinois Institute of Technology, Iowa State University, Michigan Technological University, North Carolina State University, Northeastern University, Oklahoma State University, Purdue University, Rensselaer Polytechnic Institute, Southern Methodist University, University of Alaska, University of Arizona, University of Florida, University of Idaho, University of Illinois-Urbana-Champaign, University of Kentucky, University of Maryland, University of Massachusetts, University of Minnesota, University of Missouri-Rolla, University of South Carolina, University of Southern California, University of Washington, and University of Wisconsin-Madison.[7,8]

Method of operation

Many of America's largest corporations have contracted with NTU for instruction for their employees, as have some government agencies. These sponsoring organizations include several corporate subscribers and network sponsoring sites. Corporate subscribers pay a fee which entitles them to receive instruction from NTU at any of their sites.[6] A sponsoring site pays a smaller fee to receive instruction at that site only. Tuition and fees for students enrolled in NTU courses are paid by their employers. These costs are summarized in Table 1 and are discussed later under **Cost effective continuing education.** Corporations also bear the costs of installation and maintenance of equipment to receive satellite transmissions.

Site subscriber fees	
Number of employees	*Fee*
under 500	$ 8000
500 – 1,000	12000
1,001 – 1,500	16000
1,501 – 2,000	20,000
over 2,000	24000
Corporate sponsor fees	
Number of domestic employees	*Fee*
less than 20,000	$ 65000
20,000 – 60,000	130000
60,001 – 100,000	208000
over 100,000	260000
Tuition and fees for credit	
Tuition for instruction	$231 per credit
Fees	174 per credit
Total	$405 per credit
Tuition and fees for audit	
Tuition for instruction	$128 per credit
Fees	177 per credit
Total	$305 per credit

Note: Total of tuition and fees for Rensselaer Polytechnic Institute is $500 per credit hour for students enrolled for credit and $333 per credit for students enrolled for audit. Total of tuition and fees for Southern Methodist University is $558 per credit hour for students enrolled for credit and $305 per credit for students enrolled for audit (9). Tuition and fee amounts listed are based upon semester hours. Both are adjusted for quarters according to the ratio of 3 quarter credits equals 2 semester credits (8).

Table 1. Schedule of site and student fees

Sponsoring organizations are required to provide laboratory facilities and library services on site or to make provision for them. All have computers and telecommunications equipment for use by the students in course work or for communication with instructors and advisors at the participating universities. The majority of NTU courses require no laboratory and only basic, if any, computer facilities. Other courses demand specialized

equipment. For example, Industrial Robotics requires a laboratory for 'Robot programming/teaching and operation.' Students can determine from the catalogue before registering what facilities are required and whether their sites can meet those requirements.

Instructional environment

NTU employs innovative instructional techniques and the latest technology to provide an educational environment not totally dissimilar to more traditional on-campus classes. For example, instructors may set up special interactive broadcast sessions to answer questions from students at sites where the class is viewed on videotape. This is most often done before a major examination. Instructors who utilize this forum for interacting with students report good response.

Informoation that would ordinarily be posted on bulletin boards or publicized through student newspapers is communicated to all personnel at a distance by an electronic bulletin board, a type of on-line data base which can be accessed using a computer with a modem. NTU also has a Videotex system, an electronic communication system by which anyone can ask questions of the NTU administration or make comments.[6] These systems make available to students, faculty, site coordinators, and institutional representatives current information about NTU such as class schedules, information from the *NTU Bulletin* broadcast schedules, information about ATMP short courses, and important announcements. In addition to the electronic bulletin board and Videotex systems, NTU provides an additional communication system for all faculty, AT&T electronic mail. Faculty can use this service for communicating with other faculty or administrators or to interact with students.

Class syllabi, homework assignments, and examinations are distributed throughout the semester to corporation sites, and students' work must be sent to instructors for evaulation. NTU transmits syllabi and assignments electronically to students at their work sites by one of two methods.[10] One is via video tape controller board, called Videotrax by its developer, Alpha Microsystems, which can be used in most models of PC-compatible microsystems. The controller converts data into television signals which are then broadcast in the customary manner. Computers at downlink locations convert the signals so that the data can be stored on the computer or on video tape. This method of transmitting text and graphics via satellite is called Space Text. The other method, more suitable for short documents, is the facsimile machine.[7]

In an effort significantly to improve student-instructor interaction, the transfer of documents, and the process of instruction, IBM has funded a study involving the use of instructor workstations.[11] For the IBM study, several instructors were allocated IBM-ATs configured to handle a variety of communication packages including transmission of graphics. Each AT has Alpha Micro's patented Video Communications Controller for electronically transmitting documents to students. The pilot group was trained in the use of these communications packages which they used for a year. NTU want to know if the availability of instructors' workstations significantly improves the use of electronic mail, computer conferencing, processing of homework, and the overall instructional process. If results of the study appear promising, the program will be expanded by each member of the pilot program working with one or two additional instructors who will also be allocated IBM-ATs.[12]

One of the stated goals of NTU is fostering the development of innovative technological methods of enhance learning. The efforts of NTU to work toward this goal are illustrated by their projects which include[1] replacing hard copy with Space Text as described above[2] utilizing Educational Large Area Networks (ELAN), and[3] exploring development of pseudo digital analog transmission.[11]

The ELAN project is an attempt to develop a nationwide system to enable students to dial in to a school computer, submit a program for batch computation and obtain a return later in the day. The on-campus versions of many NTU courses involve the use of custom software running on the institution's mainframe. Students gain access to the software via engineering workstations connected to the mainframe by means of a local area network. While it would be possible to connect remote workstations to the mainframe via dial up telephone lines, the performance would be unacceptable because large files must often be passed to the workstations from the mainframe. In addition, students frequently encounter difficulties in their efforts to tie into the mainframe computer at the institution from which they are receiving courses. The documentation for logging on and interfacing with the computer is generall inadequate. Students on campus can get assistance from other students or lab assistants and eventually work the problems out. A student at a site has more difficulty getting assistance and is faced with the prospect of having to learn the comparable procedures for another mainframe at another institution the next semester.

A private corporation has proposed to develop and demonstrate a high performance wide-area data network for NTU. The proposed service will utilize existing NTU satellite video transmission and reception facilities to provide an Educational Large Area Network serving NTU students at their workplaces. This would support student computing and would put the advanced resources of the institution offering the course at the immediate disposal of the NTU student who is taking that course. If the ELAN project is successful, off-campus students will have the same access to the institution's mainframe as on-campus students. In addition, this would open the possibility of remote access to super computers and specialized data bases.[11, 13]

Pseudo-digital-analogue transmission is a fundamentally different way of sending video signals. This is of interest to all educational television. Digitized compressed video is now used for some ITV with fairly satisfactory results, but there are still basic inadequacies. The system under investigation would provide a better image.[13]

It appears that many of the problems faced by NTU are inherent in the system or are at least a function of its newness. Faculty who have had experience teaching for local instructional television networks where students can call in on open lines or exchange instructional materials by couriers

often have difficulty adjusting to the communications problems presented by having students thousands of miles away. While most of the instructors and the students have technology-related backgrounds, many do not use electronic mail or even computers and are not likely to take advantage of some methods of electronic communications in spite of the ultimate benefits to both instructor and student. The facsimile machine, however, is being widely used.[7] Faculty send assignments to students in this manner and, in many instances, students 'fax' their work back to be graded. Instructors and students can both operate from the printed page, somethign with which they are familiar.

Cost-effective continuing education

Postsecondary education is becoming, for many, a lifelong process. Many factors, including the cost of a college education, however, are reducing the probability that college graduates will continue their educations long enough to obtain graduate degrees.[14] NTU offers solutions for many of these problems. Corporations can hire engineers with baccalaureate degrees who are badly needed while providing them with the opportunity to continue their education, an education benefitting both the company and the employee. Employees can take courses without leaving their wok sites and without adding many more hours to their work day. While it absorbs the costs of employee education, the company can count on a return to its investment through the engineers' abilities to make immediate on-the-job applications of their newly acquired knowledge and through their improved long-range productivity.[2]

A strong indication that business and industry believe instruction through NTU is cost-effective is that both the numbers of subscribing sites and enrolled students keep growing.[15] The number of corporate sites has grown from 15 in 1987 to 56 in 1989, and the increase in site subscribers for the same time period was from 29 to 191.[9] As seen in Table 1, the cost to companies is based both on the total number of company employees and the number of employees enrolled in NTU. A one-time subscription fee is assessed according to the number of employees at the site in the case of site subscribers, or, for corporate sponsors, the number of workers employed by the company in the United States. When the number of employees increases beyond that for which the company subscribed, there is no adjustment in the fee.[16] This fee structure has remained stable for over 3 years.

Tuition is charged as with most institutions, on a student-credit-hour basis (See Table 1.) NTU did a study of instructional television tuition in engineering in 1985.[17] Tuition at NTU, the only institution which has live nationwide programming, was between the median and the mode of the tuition costs for the institutions considered. Another study was undertaken by Robert Brady[18] of The New Jersey Institute of Technology to determine why site coordinators had chosen instructional television for training and how performance had compared with their expectations. The majority of the sites studied were members of the NTU network. The results, therefore, may be considered as reflecting views of NTU. Only 16.5% of the group perceived the cost as being a negative factor.

Many of the innovative techniques employed by NTU are designed to reduce the cost of delivering instruction. Mark Bradley, NTU's Marketing Manager, says that any high-tech company with 200 or more employees is a logical candidate for the school's courses.[13] The belief of the NTU administration in the value of the service they are providing is best illustrated by the comment of its president, Lionel Bladwin,[19] who stated, 'In the case of Bell Labs which hires 80 professors to teach employees, maybe NTU isn't better, but few companies can afford to do that.'

In the field of technology where American corporations are encountering fierce competition, not only among themselves but with other nations around the world, simply remaining abreast of current technology is not enough. The need to obtain the best instruction available is strongy felt by nations not wanting to lose ground in the struggle for economic survival. An institution such as NTU which can offer courses taught by the best professors at the nation's premier engineering schools would be attractive to most corporations regardless of cost.

NTU as a Model

In Europe a program modelled after NTU has been developed. The European Programme of Advanced Continuing Education (PACE) is based on university and industrial cooperation and will ultimately link many corporations together in nearly a dozen European countries.[20] Like NTU, PACE is not a new university competing with other institutions that provide continuing education but will complement them and will be a 'new mechanism of developing their outlets on a transnational scale.' The PACE General Report[21] states, 'The PACE proposal has drawn particularly on the lessons of the National Technological University which has been operating on a continent-wide scale since 1985. While this experience differs in many respects from what is suggested for the European Programme, it certainly provided the crucial inspiration'. Leaders have expressed a desire to ensure close cooperation with American universities and corporations and to establish appropriate exchanges.

NTU presents a model for achieving balance in an increasingly technology-based world. It provides the opportunity for balancing national needs for a better trained workforce and the immediate needs of corporations for skilled professionals. Since instruction can be broadcast to any part of the country and any size community, the equal geographical distribution of educational resources is a real possibility. Important, too, is the need to balance educational systems that have served well in the past with innovative approaches to instruction in order to reach more people in the future. It is possible that the ingenuity which creates institutions that balance hi-tech with human needs is a nation's greatest strength.[2]

References

1. Baldwin, L.V., An electronic university. *IEEE Spectrum,*

21 (11) (1984), 108-10.
2. Mays, M.E., *The historical development and future of the National Technological University*, Unpublished doctoral dissertation, University of North Texas (1988).
3. Garrison, D.R. & Shale, D., Mapping the boundaries of distance education: Problems in defining the field. *The American Journal of Distance Education*, **1** (1) (1987), 7-13.
4. Baldwin, L.V., New modes for advanced engineering study. *Engineering Education*, **73** (5) (1983), 384-9.
5. Fixmer, R., Training in the satellite age. *Dallas Inc. (Dallas Times Herald)*, Dallas, TX., 10-11, March 2-8 (1987).
6. *National Technological University, Self-Study. (1987).* (National Technological University, Fort Collins, CO, April, 1987).
7. Bradley, M.L., (Unpublished telephone interview of Marketing Manager of National Technological University by author), December 19, 1988.
8. *The National Technological University Bulletin, 1989-1990 Academic Programs* (National Technological University, Fort Collins, CO, 1989).
9. McCall, T., (Unpublished telephone interview of Director Satellite Network of National Technological University by author), June 23, 1989.
10. 'Video modem' aids in NTU broadcast system. *T.H.E. Journal*, **16** (1) (1988), 34.
11. Minutes of the Board of Trustees. (National Technological University, Fort Collins, CO) Photocopied, April 14, 1987.
12. Bradley, M.L., (Unpublished interview of the Marketing Manager of National Technological University by author at National Technological University headquarters, Fort Collins, CO), November 12-13, 1987.
13. Baldwin, L.V., (Written response of the President of National Technological University to questions by author), March 15, 1988.
14. Evangelauf, J., Experts extol anew the advantages of saving for college. *The Chronicle of Higher Education*, A1, (January 20, 1988) A32-3.
15. Bradley, M.L., (Unpublished telephone interview of Marketing Manager of National Technological University by author), May 17, 1988.
16. Yeager, D., (Unpublished telephone interview of Vice-President of Marketing of National Technological University by author), July 18, 1989.
17. Minutes of the Board of Trustees. (National Technological University, Fort Collins, CO) Photocopied, January 18, 1985.
18. Brady, R.M., The state and future of televized professional training systems. Unpublished Master's Thesis, New Jersey Institute of Technology (1987).
19. Baldwin, L.V., (Unpublished interview of the President of National Technological University by author at National Technological University headquarters, Fort Collins, CO), November 12-13, 1987.
20. Moore, M.G., Telecommunications, internationalism, and distance education. *The American Journal of Distance Education*, **2** (1) (1988), 1-7.
21. *PACE General Report 1987*, (Report of European Programme of Advanced Continuing Education), Photocopied, June 15, 1987.